# Science standards Grade 11

## Foundation level

## Scientific enquiry

By the end of Grade 11, students identify, develop and make predictions related to a clearly focused research question. They control variables, work as a team and use appropriate equipment and materials. They evaluate experimental design, identify weaknesses and develop realistic strategies for improvement. They work in an ethical manner. They understand the historical development of major ideas, through the evolution of competing models, and know that science can generate controversies, which they take part in. They record and process raw data appropriately and draw valid conclusions, allowing for errors and uncertainties. They handle equipment competently with due regard for safety. They follow instructions accurately but are able to adapt to unforeseen circumstances.

### Students should:

#### 1 Use methods of scientific investigation

1.1 Identify and develop a clearly focused research question.

Research to determine if there is a link between heart rate and body size.

Compare the tar content of different brands of cigarette.

Investigate whether the number of chromosomes an organism has is linked to characteristics such as body size or sensitivity.

Determine the percentage of sodium bicarbonate in a sample of baking powder.

Investigate the effect of different concentrations of sulfur dioxide on growing plants.

Design an experiment to show that the time taken by a object to drop is independent of its mass under conditions of negligible air resistance.

Design experiments to measure the power output of a muscle under varying conditions.

Compare the insulating properties of different roof materials and structures.

Demonstrate that infrared radiation is reflected and refracted in the same way as light.

1.2 Make predictions directly related to a research question.

Predict relationships between lung capacity and body size.

Predict whether heat will be reflected and refracted in the same way as light.

Predict the output a given logic circuit.

1.3 Identify and control variables.

Investigate the effect of exercise on the heart rates of people of different size.

Investigate the effect of different concentrations of sulfur dioxide on growing plants.

Design experiments to measure the power output of a muscle under varying conditions.

1.4 Work constructively and adaptively with others as a team on a scientific investigation.

Form teams to carry out a field study of seashore plants.

Work as a class to compare the power output of muscles.

1.5 Evaluate experimental design, identify weaknesses and develop realistic strategies for improvement.

Devise a way of determining the impact of humans on a selected habitat.

Develop an effective way of making soap by traditional methods.

Devise an effective way to compare fairly the insulating properties of different materials.

1.6 Work in an ethical manner with regard to acknowledging data sources and authenticity of results.

Interview people about their smoking habitats and present the data in a newspaper article.

Obtain information on fertiliser use over time from the Internet.

1.7 Work in an ethical manner with regard to living things and the environment.

Develop ethical guidelines to be followed when doing biological fieldwork.

1.8 Identify, and make critical use of, secondary information.

Consult reports to compare the levels of lung cancer in Qatar and neighbouring countries.

Obtain information on fertiliser use over time from the Internet.

Study material related to the Chernobyl explosion.

#### 2 Know how scientists work

2.1 Understand the historical development of the major scientific ideas.

Find out how we have come to our present understanding of the human blood system.

Study the development of the understanding of mutations.

Study the quest for an artificial nitrogenous fertiliser in agriculture.

Study the development of our understanding of the phenomenon of radioactivity.

Study the development of our understanding of the nature of the electron.

2.2 Know that many scientific topics are controversial, causing debates both between scientists and also among the general public, and be able to take part in such debates in an informed manner.

Research and debate different explanations for the increased numbers of people with asthma.

Present evidence related to the possible effects of passive smoking.

Debate the use of renewable versus fossil fuels.

Debate the desirability of increasing our use of nuclear energy.

2.3 Know that scientists work by building conceptual models that can be tested by experiment, and realise the value of controversy around competing models.

Find out why the Krebs cycle is so named.

Study the development of competing models of atomic structure and chemical bonding.

Study the development of our understanding of the nature of the electron, from a wave to a particle to wave–particle duality.

#### 3 Process and communicate information

3.1 Record raw data appropriately in a manner that allows easy interpretation.

Prepare charts to illustrate differences in tidal volume and lung capacity and whether this differs with chest size.

Use graphical extrapolation to show absolute zero.

Use multiflash photography to illustrate the acceleration of a falling ball.

3.2 Process raw data by the most appropriate means.

Use graphs to depict changes in heart rate over time.

Draw conclusions on the half-life of radioisotopes using a graphical method.

3.3 Draw valid conclusions, allowing for errors and uncertainties.

Understand the importance of multiple readings of radioactive disintegrations to arrive at a statistical average.

3.4 Use an appropriate range of methods to communicate scientific information.

Write a magazine article aimed at alerting young people to the health risks of smoking.

Use models to show organic molecular structures.

Use flow charts to show industrial processes.

#### 4 Handle equipment and make measurements

4.1 Select and use correctly and competently the appropriate equipment and materials for an investigation, with due regard for the safety of self and others.

Use a spirometer to measure lung capacity and tidal volume.

Use an oscilloscope to study alternating current and induced voltages.

Carry out work with radioactive materials safely.

4.2 Follow instructions accurately but be able to adapt to unforeseen circumstances.

For Grade 11, foundation level, the weightings of the assessment objectives to be applied to each content strand are as follows:

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|  | Knowledge and understanding | Application, analysis and evaluation | Scientific enquiry skills and procedures |
| Assessment weighting | 45 to 55% | 25 to 35% | 20 to 25% |